PEEBEDU

Cell Diffusion Explorer

Name: _____ **Period:** _____ **Date:** _____

> Open **peebedu.com** and navigate to **Cell Diffusion Explorer**. Click the **Start Experimenting!** button to begin. Read the introduction popup, which describes diffusion, the surface area-to-volume (SA/V) ratio, and why cell shape matters for efficient material exchange.

Free Response Questions

Question 1 — Conceptual Analysis

> **Simulation Task:** *Drag the* **Star** *shape (SA: 355.9) and the* **Crescent** *shape (SA: 162.1) into the beaker. Calculate the SA/V ratio for each shape (both have V = 100). Click* **Start / Resume All** *and observe which shape completes diffusion first. Note the difference in how quickly each shape fills with color.*

(A) (1 pt) **Describe** the condition that must exist across a cell's membrane for passive transport of a substance to occur.

(B) (1 pt) **Explain** why the star-shaped cell completes diffusion before the crescent-shaped cell, given that both cells have the same volume but different surface areas.

(C) (1 pt) **Predict** how the rate of nutrient uptake by passive transport would change for an intestinal epithelial cell if a mutation caused it to lose its microvilli, reducing its surface area while its volume remained unchanged.

(D) (1 pt) **Justify** your prediction.

2.5.A.1, 2.5.A.2

Question 2 — Analyze Model / Visual Representation

> **Simulation Task:** *Drag the* **Circle** *shape (SA: 251.4), the* **Tall Rectangle** *shape (SA: 200.0), and the* **Amoeba** *shape (SA: 251.2) into the beaker. Note that the Circle and Amoeba have nearly identical surface areas despite very different shapes. Click* **Start / Resume All** *and observe the diffusion rates for all three shapes.*

(A) (1 pt) **Describe** the relationship between a cell's surface area-to-volume ratio and the efficiency with which it exchanges materials with its environment.

(B) (1 pt) **Explain** why a cell that doubles in diameter while keeping the same shape becomes less efficient at exchanging materials with its environment.

(C) (1 pt) **Represent** how cell shape affects diffusion efficiency by drawing two cells with the same volume -- one compact and spherical, one elongated with membrane projections -- using arrows to show the relative rate of diffusion across each cell's membrane and labeling the surface area-to-volume ratio for each.

Draw your diagram here.

(D) (1 pt) **Explain** how the hydrophobic interior of the plasma membrane limits which substances can diffuse across the membrane surface you drew.

2.2.A.1, 2.2.A.2